COMPUTER VISION LAB.,
School of Artificial Intelligence,
Inha University

Meeting 23.03.09

COMPUTER VISION LAB

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CONTENTS

- **Adaptive Frequency Ratio Scheduler**

Adaptive Frequency Ratio Scheduler

- **Motivation**
  - High-frequency component contains noise.
  - Learn from easy to difficult tasks

Adaptive Frequency Ratio Scheduler

- **Motivation**
  - High-frequency component contains noise.
  - Learn from ***easy*** to ***difficult*** tasks

Find approximate location of RoIs

Find details of RoI

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- **Motivation**
  - Experiment : Fixed Frequency Ratio (Cutout high-frequency)
    - Backbone : Unet
    - Epoch : 200
    - Batch Size : 16
    - Optimizer : Adam with learning rate : 0.0001
    - Learning rate scheduler : Cosine Annealing Scheduler (0.0001 → 0.000001)
    - Dataset : Kvasir-SEG & CVC-ClinicDB

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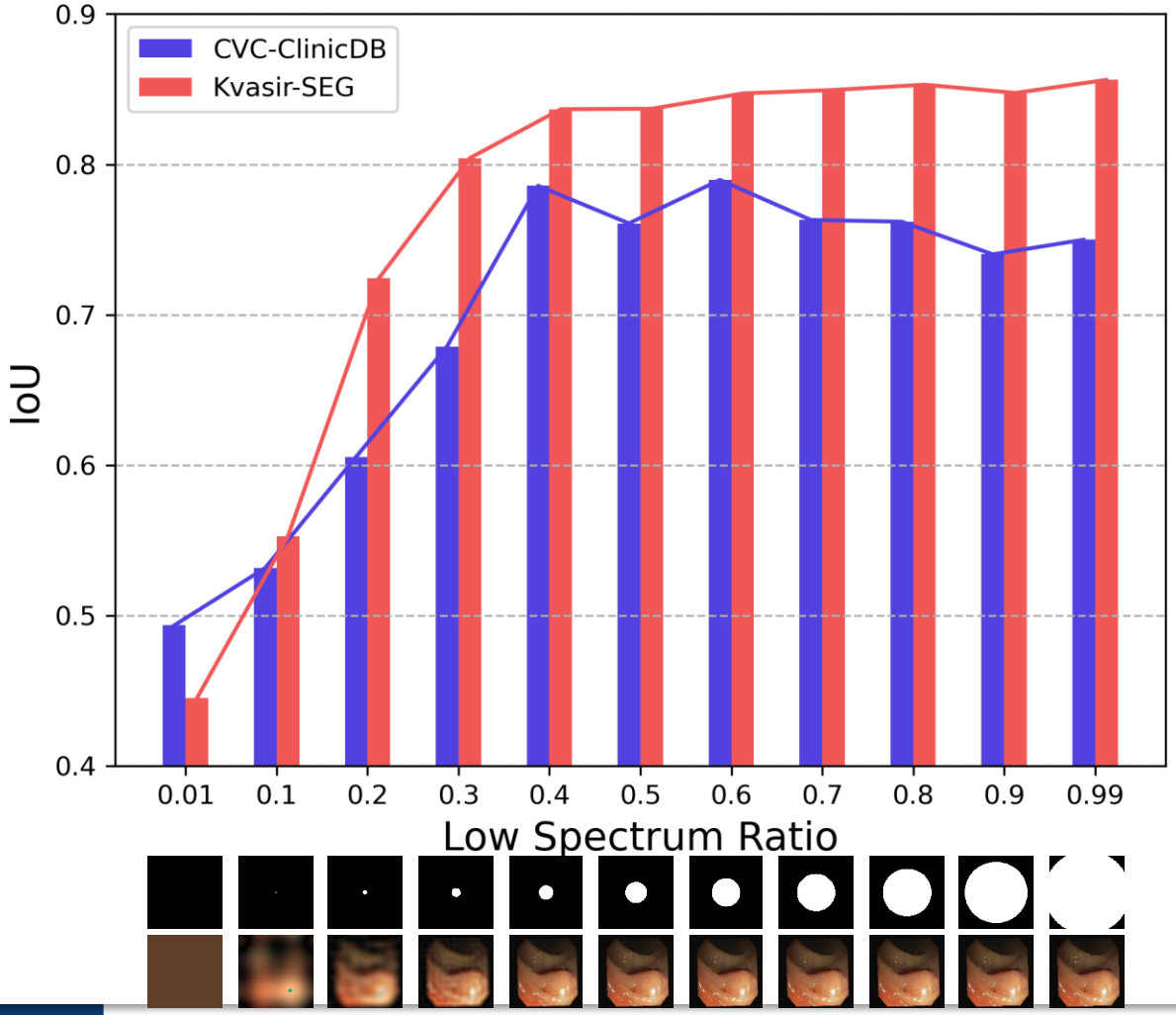
- **Motivation**
  - Experiment : Fixed Frequency Ratio (Cutout high-frequency)



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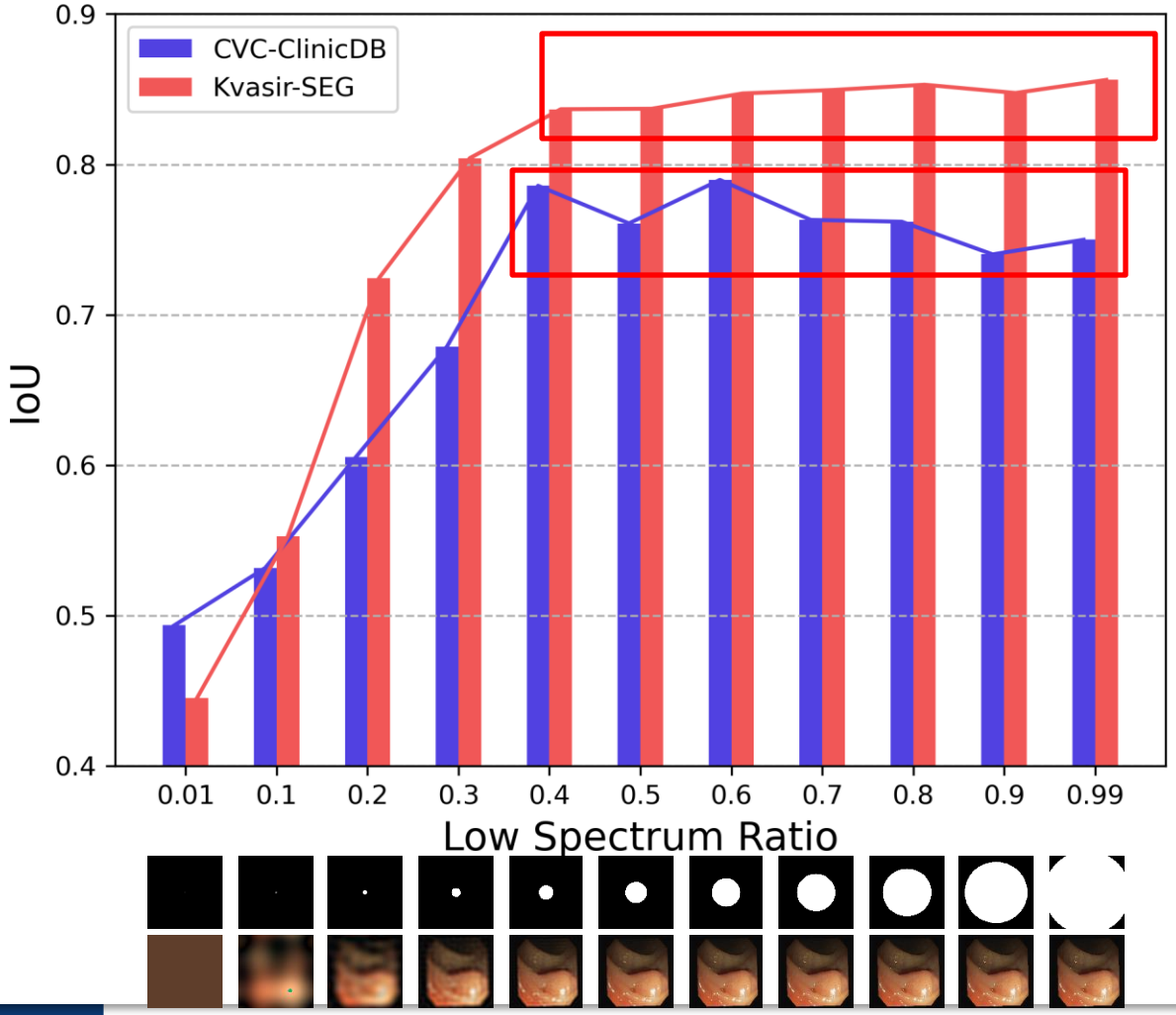
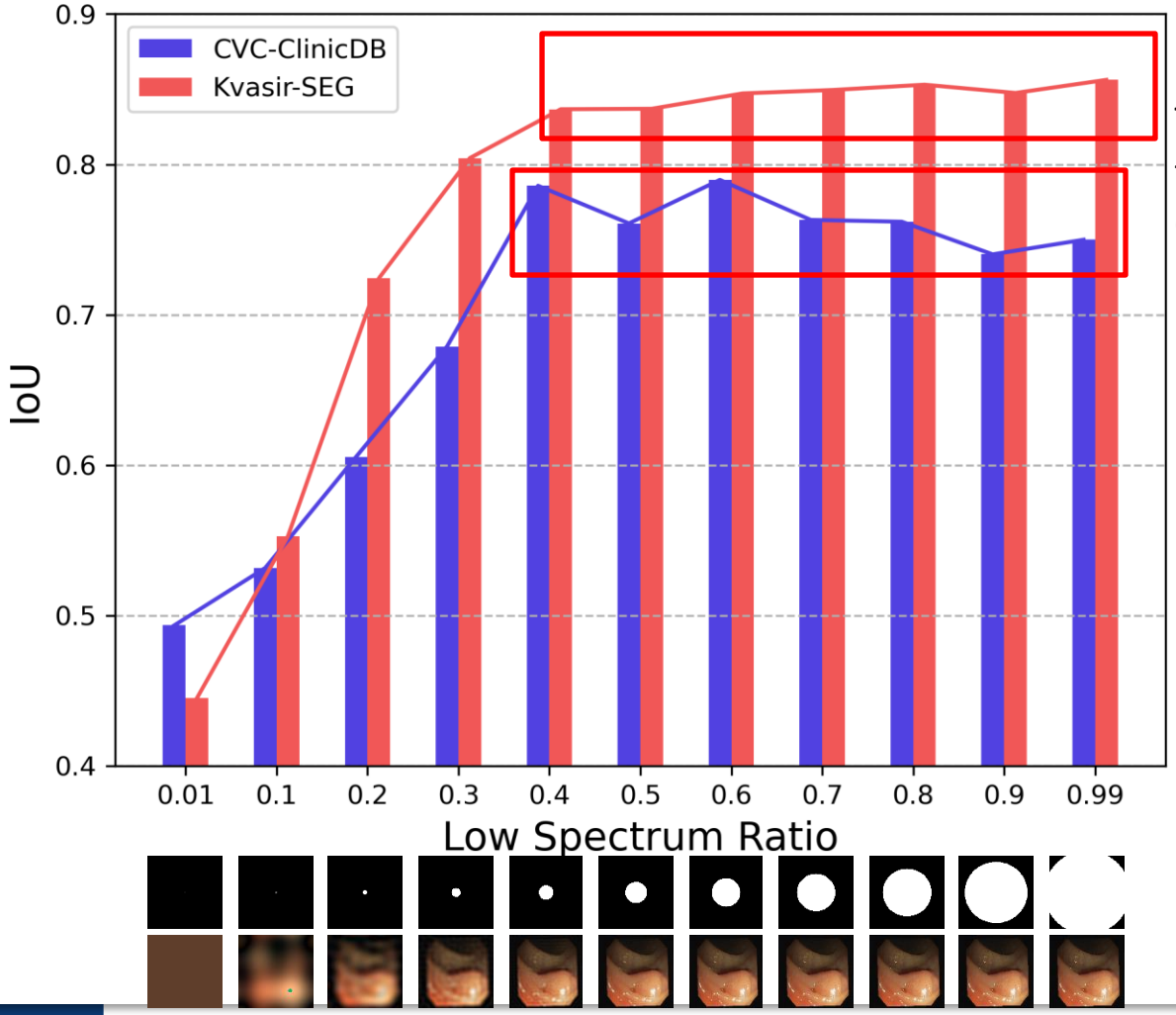
- **Motivation**
  - Experiment : Fixed Frequency Ratio (Cutout high-frequency)



Adaptive Frequency Ratio Scheduler

- **Motivation**
  - Experiment : Fixed Frequency Ratio (Cutout high-frequency)



There exists **optimal** frequency ratio per dataset!!

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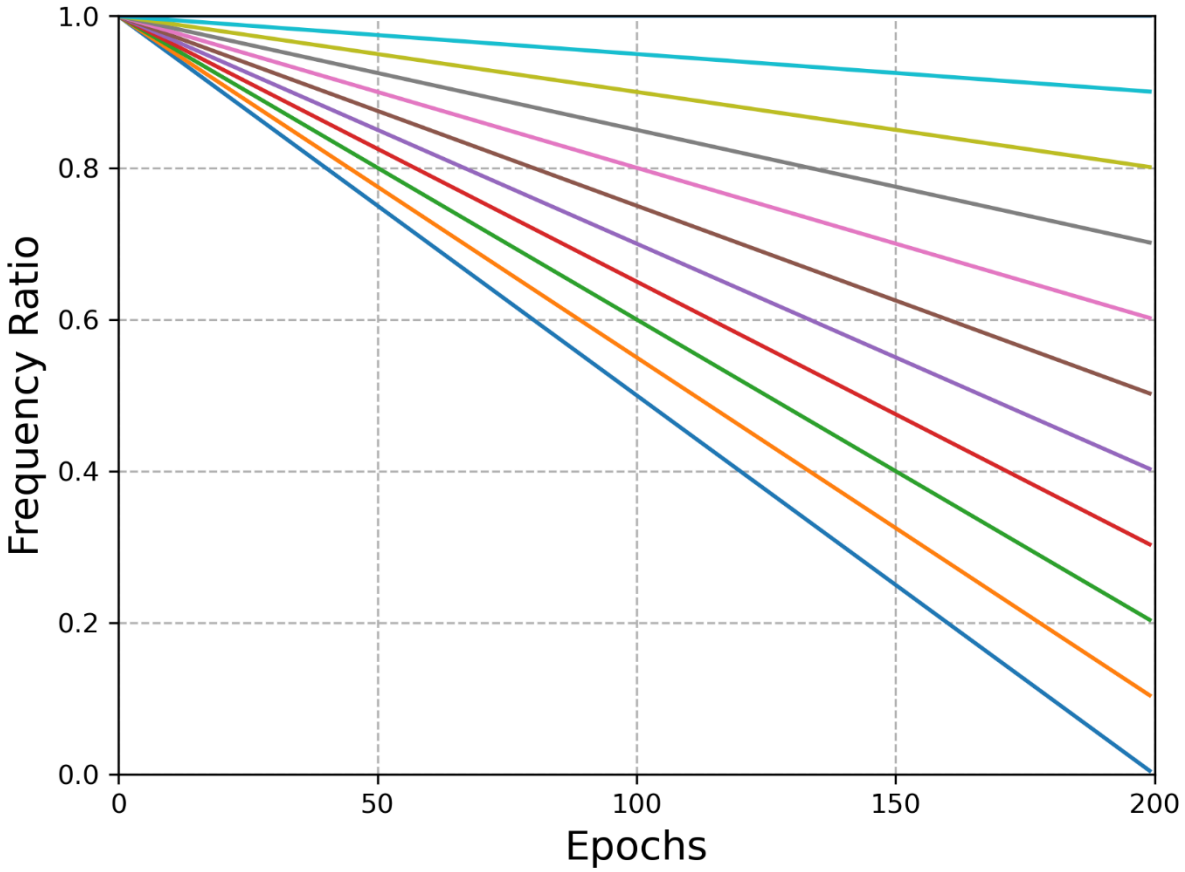
- **Adaptive Frequency Ratio Scheduler**
  - Negative Linear Scheduler



- **Adaptive Frequency Ratio Scheduler**
  - Negative Linear Scheduler

	CVC-ClinicDB				
Final FR	Pixel Accuracy	F1-Score	Precision	Recall	IoU
0.9	0.9732	0.8307	0.8207	0.8882	0.7622
0.8	**0.9755**	0.8288	0.8143	0.8851	0.7645
0.7	0.9708	0.8115	0.7971	0.8759	0.7451
0.6	0.9749	**0.838**	**0.8322**	**0.8956**	**0.7697**
0.5	0.9639	0.8122	0.7767	0.91	0.737
0.4	0.9625	0.749	0.7364	0.8008	0.6859
0.3	0.8826	0.6322	0.6173	0.7618	0.5515
0.2	0.926	0.5272	0.5506	0.5419	0.4925
0.1	0.8991	0.4811	0.4871	0.4798	0.4536
0	0.4622	0.3404	0.4901	0.3886	0.2422

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- **Adaptive Frequency Ratio Scheduler**
  - Negative Linear Scheduler

	Kvasir-SEG				
Final FR	Pixel Accuracy	F1-Score	Precision	Recall	IoU
0.9	**0.9634**	**0.9053**	0.9193	**0.9171**	**0.8558**
0.8	0.9603	0.8959	0.9143	0.9037	0.8453
0.7	0.9581	0.8933	**0.9211**	0.896	0.839
0.6	0.9409	0.8334	0.9066	0.8217	0.7721
0.5	0.8997	0.6532	0.7287	0.6542	0.6006
0.4	0.8738	0.544	0.6032	0.5645	0.4992
0.3	0.795	0.5282	0.5515	0.5554	0.4521
0.2	0.7514	0.5325	0.5547	0.587	0.4399
0.1	0.4316	0.3823	0.5609	0.6257	0.2589
0	0.6449	0.5103	0.5579	0.6391	0.3896

- **Adaptive Frequency Ratio Scheduler**
  - Question : How to find optimal frequency ratio??

    Condition 1. Maximally utilize the saliency information of input

    Condition 2. Maximally decrease the noise of input

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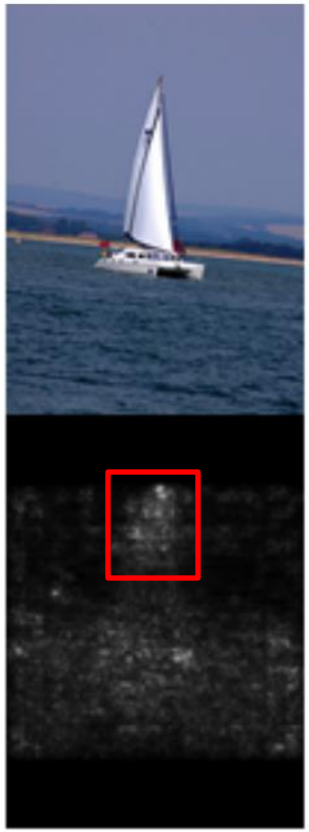
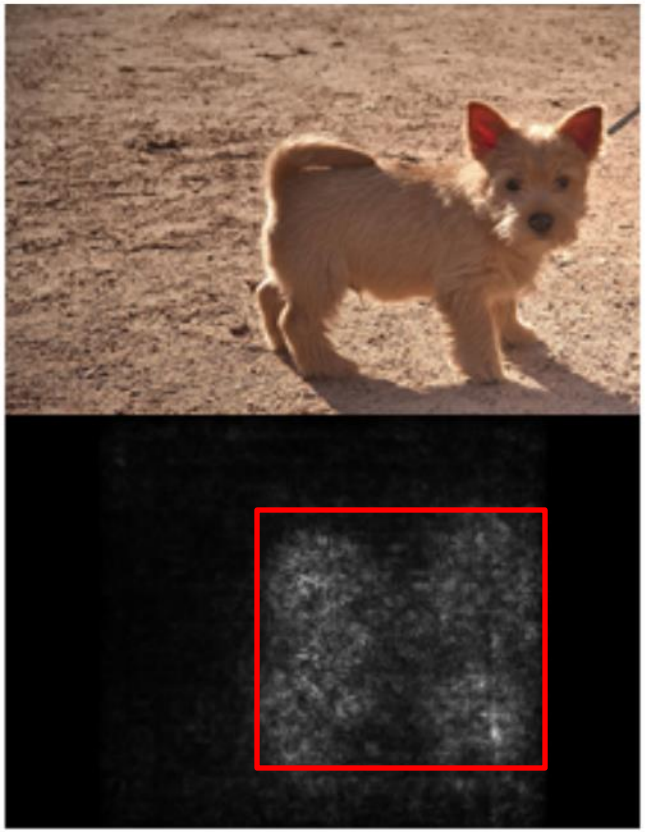
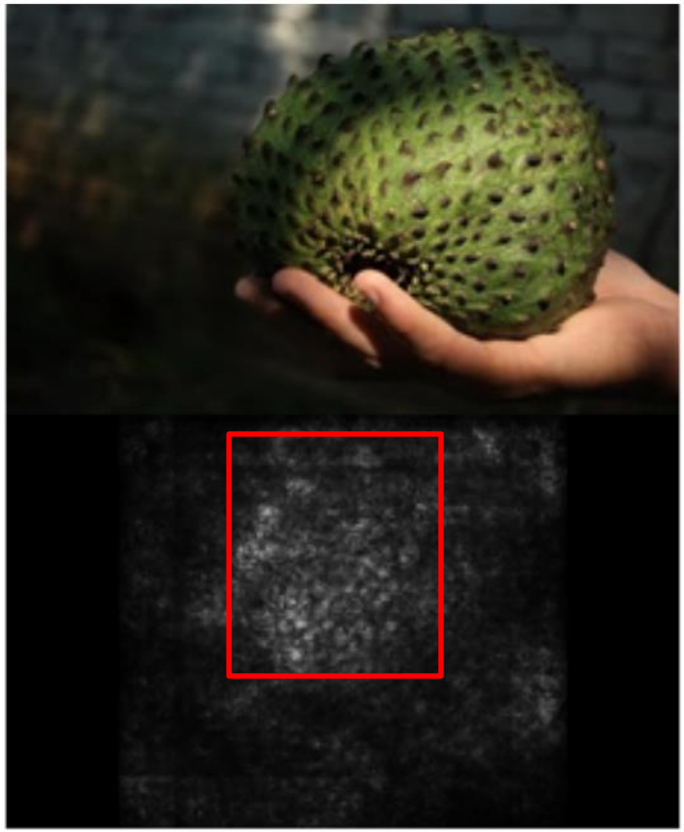
- **Adaptive Frequency Ratio Scheduler**
  - Question : How to find optimal frequency ratio??

    Condition 1. Maximally utilize the saliency information of input
    - Saliency information = Gradient of a pre-trained DNN







- **Adaptive Frequency Ratio Scheduler**
  - Question : How to find optimal frequency ratio??

    Condition 1. Maximally utilize the saliency information of input

$$\max_{r\in(0.0,1.0)} \left(s\left(\mathfrak{F}^{-1}\{\mathbf{M}(r)\odot\mathfrak{F}\{x\}\}\right) + s(\mathfrak{F}^{-1}\{(\mathbf{1} - \mathbf{M}(r))\odot\mathfrak{F}\{x\}\})\right)$$

    - x : input image
    - $\mathfrak{F}\{\cdot\}, \mathfrak{F}^{-1}\{\cdot\}$: Discrete Fourier Transform (DFT) & Inverse DFT
    - $\odot$: Element-wise Multiplication
    - $\mathbf{M}(r)$: Low-frequency mask with r frequency ratio
    - $s(\cdot)$: The ***saliency*** of the input data, **computed by taking l_2 norm of gradient values across input channels**

- **Adaptive Frequency Ratio Scheduler**
  - Question : How to find optimal frequency ratio??

    Condition 2. Maximally decrease the noise of input

$$\min_{r\in(0.0,1.0)} \left(\sigma\left(\mathfrak{F}^{-1}\{\mathbf{M}(r)\odot\mathfrak{F}\{x\}\}\right) + \sigma(\mathfrak{F}^{-1}\{(\mathbf{1} - \mathbf{M}(r))\odot\mathfrak{F}\{x\}\})\right)$$

    - x : input image
    - $\mathfrak{F}\{\cdot\}, \mathfrak{F}^{-1}\{\cdot\}$: Discrete Fourier Transform (DFT) & Inverse DFT
    - $\odot$: Element-wise Multiplication
    - $\mathbf{M}(r)$: Low-frequency mask with r frequency ratio
    - $\sigma(\cdot)$: The ***total variance*** of the input data

- **Adaptive Frequency Ratio Scheduler**
  - Question : How to find optimal frequency ratio??
    - **Final Objective function**

$$\min_{r\in(0.0,1.0)} \left(\begin{array}{l} \underbrace{-\alpha\left(s\left(\mathfrak{F}^{-1}\{\mathbf{M}(r)\odot\mathfrak{F}\{x\}\}\right)+s\left(\mathfrak{F}^{-1}\{(\mathbf{1}-\mathbf{M}(r))\odot\mathfrak{F}\{x\}\}\right)\right)}_{\text{Condition1}} \\ \underbrace{+\beta\left(\sigma\left(\mathfrak{F}^{-1}\{\mathbf{M}(r)\odot\mathfrak{F}\{x\}\}\right)+\sigma\left(\mathfrak{F}^{-1}\{(\mathbf{1}-\mathbf{M}(r))\odot\mathfrak{F}\{x\}\}\right)\right)}_{\text{Condition2}} \end{array} \right)$$

Adaptive Frequency Ratio Scheduler

- **Future work**
  - **Find optimization method**